

IN THE CLAIMS:

Please amend the claims as follows.

- 8517
1. (Currently Amended) ~~An~~ The optical head ~~comprising~~ of claim 52, wherein the plurality of wavelengths comprises

at least one light source for emitting a beam with a first wavelength and a beam with a second wavelength that is approximately twice as long as the first wavelength;

a photodetector; and

at least one diffractive optical element provided in optical paths of the beams with the first and the second wavelengths;

wherein outgoing light from said at least one diffractive optical element the first diffraction light is substantially a second-order diffraction light with respect to the beam with the first wavelength and the second diffraction light is substantially a first-order diffraction light with respect to the beam with the second wavelength.

2. (Original) The optical head according to claim 1,

wherein said at least one diffractive optical element has a cross section substantially of a sawtooth shape, and with respect to the first wavelength λ_1 , the second wavelength λ_2 , and a refractive index n of a material of said at least one diffractive optical element, groove depth in the sawtooth shape is substantially in a range between $2\lambda_1 / (n-1)$ and $\lambda_2 / (n-1)$ in the case of a transmission element, is substantially in a range between λ_1 / n and $\lambda_2 / 2n$ in the case of a reflection element onto which beams are incident from a substrate side, and is substantially in a range between λ_1 and $\lambda_2 / 2$ in the case of a reflection element onto which beams are incident from an air side.

3. (Original) The optical head according to claim 1,
wherein said at least one diffractive optical element is an objective lens for focusing
beams on an information recording medium.
4. (Original) The optical head according to claim 1,
wherein said at least one diffractive optical element is a collimator lens for
collimating beams emitted from said at least one light source substantially into parallel
beams.
5. (Original) The optical head according to claim 1,
wherein said at least one diffractive optical element is a focusing/tracking error
signal detection element.
6. (Original) The optical head according to claim 1,
wherein with respect to the first wavelength λ_1 , a minimum period Λ_{\min} of said at
least one diffractive optical element satisfies a relationship of $\Lambda_{\min} \geq 10\lambda_1$.
7. (Original) The optical head according to claim 1,
wherein with respect to the first wavelength λ_1 , a minimum period Λ_{\min} of the
diffractive optical element satisfies a relationship of $\Lambda_{\min} \geq 22\lambda_1$.

8. (Original) The optical head according to claim 1,

wherein the optical head further comprises a refraction optical element having optical surfaces onto which beams emitted from said at least one light source are incident obliquely, the refraction optical element is provided in optical paths of the beams with the first and the second wavelengths, and a diffraction angle of light diffracted by said at least one diffractive optical element due to variation in wavelength of the beams emitted from said at least one light source and a refraction angle of light refracted by the refraction optical element are changed in directions that enable the beams to be canceled out with each other.

9. (Original) The optical head according to claim 8,

wherein said at least one diffractive optical element is a grating with a uniform period.

10. (Original) The optical head according to claim 8,

wherein said at least one diffractive optical element is positioned in a converging light optical path or a diverging light optical path with a numerical aperture of 0.39 or less, and said at least one diffractive optical element has a uniform period.

11. (Original) The optical head according to claim 8,

wherein the refraction optical element is a prism with three optical surfaces, and when in the three optical surfaces, a surface on a side of an information recording medium is a first surface, a surface on a side of said at least one light source is a second

surface, and a surface other than those is a third surface, the refraction optical element is designed so that the beams emitted from said at least one light source pass through the second surface, are reflected by the first and the third surfaces sequentially, and then pass through the first surface, and a bottom part of an objective lens is located lower than a highest position of the beams entering the second surface that have been emitted from said at least one light source.

12. (Original) The optical head according to claim 11,
wherein a glass material of the prism has an Abbe number of at least 64.

13. (Original) The optical head according to claim 1,
wherein said light source is an SHG light source that emits beams with two wavelengths.

14. (Original) The optical head according to claim 1,
wherein the optical head further comprises a transparent substrate in which the beams with the first and the second wavelengths propagate in a zigzag manner, and said at least one diffractive optical element is positioned on the transparent substrate.

15. (Original) The optical head according to claim 1,
wherein the first wavelength λ_1 satisfies a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$
or the second wavelength λ_2 satisfies a relationship of $0.76\mu\text{m} \leq \lambda_2 \leq 0.88\mu\text{m}$.

16. (Original) The optical head according to claim 1,

wherein the first wavelength λ_1 satisfies substantially a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$, and said at least one diffractive optical element is a chromatic-aberration compensation element for compensating chromatic aberration caused by an objective lens for focusing beams on an information recording medium.

17. (Currently Amended) ~~An~~ The optical head comprising: of claim 52, further comprising

~~at least one light source for emitting a beam with a first wavelength and a beam with a second wavelength that is approximately twice as long as the first wavelength;~~

~~a photodetector;~~

~~an objective lens for focusing beams on an information recording medium; and~~

~~a diffractive optical element provided in optical paths of the beams with the first and the second wavelengths;~~

wherein the plurality of wavelengths comprises a first wavelength and a second wavelength that is approximately twice as long as the first wavelength;

wherein the diffractive optical element is a chromatic-aberration compensation element that compensates chromatic aberration caused by the objective lens and that has difference in level of a step-like shape or grooves substantially of a sawtooth shape, and with respect to the first wavelength λ_1 , the second wavelength λ_2 , and a refractive index n of a material of the chromatic-aberration compensation element, the difference in level or depth of the grooves is in a range substantially between $2\lambda_1 / (n-1)$ and $\lambda_2 / (n-1)$.

18. (Original) The optical head according to claim 17,
wherein the first wavelength λ_1 satisfies a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$
or the second wavelength λ_2 satisfies a relationship of $0.76\mu\text{m} \leq \lambda_2 \leq 0.88\mu\text{m}$.

19. (Original) The optical head according to claim 17,
wherein the chromatic-aberration compensation element is formed on the objective
lens.

20. (Original) The optical head according to claim 17,
wherein the chromatic-aberration compensation element and the objective lens are
driven together by an actuator.

21. (Original) The optical head according to claim 17,
wherein the chromatic-aberration compensation element is a convex diffractive lens
and forms converging light in cooperation with the objective lens.

22. (Currently Amended) ~~An~~ The optical head comprising: of claim 52, wherein the
plurality of wavelengths comprises

~~at least one light source for emitting a beam with a first wavelength, a beam with a
second wavelength that is approximately twice as long as the first wavelength, and a
beam with a third wavelength that is approximately 1.5 times as long as the first
wavelength;~~

~~a photodetector; and~~

~~at least one diffractive optical element provided in optical paths of the beams with~~
~~the first, the second, and the third wavelengths,~~

wherein ~~outgoing light from said at least one diffractive optical element~~ the first
diffraction light is substantially a fourth-order diffraction light with respect to the beam
with the first wavelength, the second diffraction light is substantially a second-order
diffraction light with respect to the beam with the second wavelength, and a third
diffraction light is substantially a third-order diffraction light with respect to the beam
with the third wavelength.

23. (Original) The optical head according to claim 22,

wherein said at least one diffractive optical element has a cross section substantially
of a sawtooth shape, and with respect to the first wavelength λ_1 , the second wavelength
 λ_2 , the third wavelength λ_3 , and a refractive index n of a material of said at least one
diffractive optical element, groove depth in the sawtooth shape is substantially in a range
between a minimum and a maximum among $4\lambda_1 / (n-1)$, $2\lambda_2 / (n-1)$, and $3\lambda_3 / (n-1)$ in the
case of a transmission element, is substantially in a range between a minimum and a
maximum among $2\lambda_1 / n$, λ_2 / n , and $3\lambda_3 / 2n$ in the case of a reflection element onto
which beams are incident from a substrate side, and is substantially in a range between a
minimum and a maximum among $2\lambda_1$, λ_2 , and $3\lambda_3 / 2$ in the case of a reflection element
onto which beams are incident from an air side.

24. (Original) The optical head according to claim 22,

wherein with respect to the first wavelength λ_1 , a minimum period Λ_{\min} of said at

least one diffractive optical element satisfies a relationship of $\Lambda_{\min} \geq 22\lambda_1$.

25. (Original) The optical head according to claim 22,

wherein the first wavelength λ_1 satisfies a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$, the second wavelength λ_2 satisfies a relationship of $0.76\mu\text{m} \leq \lambda_2 \leq 0.88\mu\text{m}$, or the third wavelength λ_3 satisfies a relationship of $0.57\mu\text{m} \leq \lambda_3 \leq 0.68\mu\text{m}$.

26. (Original) The optical head according to claim 22,

wherein the first wavelength λ_1 satisfies substantially a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$, and said at least one diffractive optical element is a chromatic-aberration compensation element for compensating chromatic aberration caused by an objective lens for focusing beams on an information recording medium.

27. (Currently Amended) ~~An~~ The optical head comprising: ~~of claim 52, further comprising~~

~~at least one light source for emitting a beam with a first wavelength, a beam with a second wavelength that is approximately twice as long as the first wavelength, and a beam with a third wavelength that is approximately 1.5 times as long as the first wavelength;~~

~~a photodetector;~~

~~an objective lens for focusing beams on an information recording medium; and~~

~~at least one diffractive optical element provided in optical paths of the beams with the first, the second, and the third wavelengths,~~

wherein the plurality of wavelengths comprises a first wavelength a second wavelength that is approximately twice as long as the first wavelength, and a third wavelength that is approximately 1.5 times as long as the first wavelength;

wherein said at least one diffractive optical element is a chromatic-aberration compensation element that compensates chromatic aberration caused by the objective lens and has difference in level of a step-like shape or grooves substantially of a sawtooth shape, and with respect to the first wavelength λ_1 , the second wavelength λ_2 , the third wavelength λ_3 , and a refractive index n of a material of said at least one diffractive optical element, the difference in level or depth of the grooves is in a range between a minimum and a maximum among $4\lambda_1 / (n-1)$, $2\lambda_2 / (n-1)$, and $3\lambda_3 / (n-1)$.

28. (Original) The optical head according to claim 27,

wherein the first wavelength λ_1 satisfies a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$, the second wavelength λ_2 satisfies a relationship of $0.76\mu\text{m} \leq \lambda_2 \leq 0.88\mu\text{m}$, or the third wavelength λ_3 satisfies a relationship of $0.57\mu\text{m} \leq \lambda_3 \leq 0.68\mu\text{m}$.

29. (Original) The optical head according to claim 27,

wherein the chromatic-aberration compensation element is formed on the objective lens.

30. (Original) The optical head according to claim 27,

wherein the chromatic-aberration compensation element and the objective lens are driven together by an actuator.

31. (Original) The optical head according to claim 27,

wherein the chromatic-aberration compensation element is a convex diffractive lens and forms converging light in cooperation with the objective lens.

32. (Currently Amended) ~~An~~ The optical head comprising: ~~of claim 52, wherein the plurality of wavelengths comprises~~

~~at least one light source for emitting a beam with a first wavelength and a beam with a second wavelength that is approximately 1.5 times as long as the first wavelength;~~

~~a photodetector; and~~

~~at least one diffractive optical element provided in optical paths of the beams with the first and the second wavelengths;~~

~~wherein outgoing light from said at least one diffractive optical element~~ the first diffraction light is substantially a third-order diffraction light with respect to the beam with the first wavelength and the second diffraction light is substantially a second-order diffraction light with respect to the beam with the second wavelength.

33. (Original) The optical head according to claim 32,

wherein said at least one diffractive optical element has a cross section substantially of a sawtooth shape, and with respect to the first wavelength λ_1 , the second wavelength λ_2 , and a refractive index n of a material of said at least one diffractive optical element, groove depth in the sawtooth shape is substantially in a range between $3\lambda_1 / (n-1)$ and $2\lambda_2 / (n-1)$ in the case of a transmission element, is substantially in a range between $3\lambda_1 / 2n$

and λ_2 / n in the case of a reflection element onto which beams are incident from a substrate side, and is substantially in a range between $3\lambda_1 / 2$ and λ_2 in the case of a reflection element onto which beams are incident from an air side.

34. (Original) The optical head according to claim 32,
wherein with respect to the first wavelength λ_1 , a minimum period Λ_{\min} of said at least one diffractive optical element satisfies a relationship of $\Lambda_{\min} \geq 16\lambda_1$.

35. (Original) The optical head according to claim 32,
wherein the first wavelength λ_1 satisfies a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$ or the second wavelength λ_2 satisfies a relationship of $0.57\mu\text{m} \leq \lambda_2 \leq 0.68\mu\text{m}$.

36. (Original) The optical head according to claim 32,
wherein the first wavelength λ_1 satisfies substantially a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$, and said at least one diffractive optical element is a chromatic-aberration compensation element for compensating chromatic aberration caused by an objective lens for focusing beams on an information recording medium.

37. (Currently Amended) ~~An~~ The optical head comprising ~~comprising~~ of claim 52, further comprising

~~at least one light source for emitting a beam with a first wavelength and a beam with a second wavelength that is approximately 1.5 times as long as the first wavelength;~~
~~a photodetector;~~

an objective lens for focusing beams on an information recording medium; and
~~a diffractive optical element provided in optical paths of the beams with the first and
the second wavelengths,~~

wherein the plurality of wavelengths comprises a first wavelength and a beam with
a second wavelength that is approximately 1.5 times as long as the first wavelength;

wherein the diffractive optical element is a chromatic-aberration compensation
element that compensates chromatic aberration caused by the objective lens and that has
difference in level of a step-like shape or grooves substantially of a sawtooth shape, and
with respect to the first wavelength λ_1 , the second wavelength λ_2 , and a refractive index n
of a material of the chromatic-aberration compensation element, the difference in level or
depth of the grooves is substantially in a range between $3\lambda_1 / (n-1)$ and $2\lambda_2 / (n-1)$.

38. (Original) The optical head according to claim 37,

wherein the first wavelength λ_1 satisfies a relationship of $0.35\mu\text{m} \leq \lambda_1 \leq 0.44\mu\text{m}$
or the second wavelength λ_2 satisfies a relationship of $0.57\mu\text{m} \leq \lambda_2 \leq 0.68\mu\text{m}$.

39. (Original) The optical head according to claim 37,


wherein the chromatic-aberration compensation element is formed on the objective
lens.

40. (Original) The optical head according to claim 37,

wherein the chromatic-aberration compensation element and the objective lens are
driven together by an actuator.

41. (Original) The optical head according to claim 37,
wherein the chromatic-aberration compensation element is a convex diffractive lens
and forms converging light in cooperation with the objective lens.

42. (Currently Amended) ~~An~~ The optical head comprising ~~of claim 52, wherein the~~
plurality of wavelengths comprises

 ~~at least one light source for emitting a beam with a first wavelength, a beam with a~~
~~second wavelength that is approximately twice as long as the first wavelength, and a~~
~~beam with a third wavelength that is approximately 1.5 times as long as the first~~
wavelength;

~~a photodetector; and~~

~~at least one diffractive optical element provided in optical paths of the beams with~~
~~the first, the second, and the third wavelengths;~~

~~wherein outgoing light from said at least one diffractive optical element~~ the first
diffraction light is substantially a sixth-order diffraction light with respect to the beam
with the first wavelength, the second diffraction light is substantially a third-order
diffraction light with respect to the beam with the second wavelength, and the third
diffraction light is substantially a fourth-order diffraction light with respect to the beam
with the third wavelength.

43. (Original) The optical head according to claim 42,

wherein said at least one diffractive optical element has a cross section substantially of a sawtooth shape, and with respect to the first wavelength λ_1 , the second wavelength λ_2 , the third wavelength λ_3 , and a refractive index n of a material of said at least one diffractive optical element, groove depth in the sawtooth shape is substantially in a range between a minimum and a maximum among $6\lambda_1 / (n-1)$, $3\lambda_2 / (n-1)$, and $4\lambda_3 / (n-1)$ in the case of a transmission element, is substantially in a range between a minimum and a maximum among $3\lambda_1 / n$, $3\lambda_2 / 2n$, and $2\lambda_3 / n$ in the case of a reflection element onto which beams are incident from a substrate side, and is substantially in a range between a minimum and a maximum among $3\lambda_1$, $3\lambda_2 / 2$, and $2\lambda_3$ in the case of a reflection element onto which beams are incident from an air side.

44. (Currently Amended) ~~An~~ The optical head comprising ~~comprising~~ of claim 52, further comprising

~~at least one light source for emitting a beam with a first wavelength, a beam with a second wavelength that is approximately twice as long as the first wavelength, and a beam with a third wavelength that is approximately 1.5 times as long as the first wavelength;~~

~~a photodetector;~~

~~an objective lens for focusing beams on an information recording medium; and~~

~~at least one diffractive optical element provided in optical paths of the beams with the first, the second, and the third wavelengths,~~

wherein the plurality of wavelengths comprises a first wavelength a second

wavelength that is approximately twice as long as the first wavelength, and a third wavelength that is approximately 1.5 times as long as the first wavelength;

wherein said at least one diffractive optical element is a chromatic-aberration compensation element that compensates chromatic aberration caused by the objective lens and that has difference in level of a step-like shape or grooves substantially of a sawtooth shape, and with respect to the first wavelength λ_1 , the second wavelength λ_2 , the third wavelength λ_3 , and a refractive index n of a material of said at least one diffractive optical element, the difference in level or depth of the grooves is substantially in a range between a minimum and a maximum among $6\lambda_1 / (n-1)$, $3\lambda_2 / (n-1)$, and $4\lambda_3 / (n-1)$.

45. (Original) The optical head according to claim 44,

wherein the chromatic-aberration compensation element is formed on the objective lens.

46. (Original) The optical head according to claim 44,

wherein the chromatic-aberration compensation element and the objective lens are driven together by an actuator.

47. (Original) The optical head according to claim 44,

wherein the chromatic-aberration compensation element is a convex diffractive lens and forms converging light in cooperation with the objective lens.

48. (Currently Amended) ~~An~~ The optical head comprising of claim 52, wherein the plurality of wavelengths comprises

~~a light source emitting a beam with a wavelength λ that satisfies substantially a relationship of $0.35\mu\text{m} \leq \lambda \leq 0.44\mu\text{m}$;~~

~~a photodetector; and~~

~~at least one diffractive optical element provided in an optical path of the beam emitted from the light source;~~

~~wherein said at least one diffractive optical element is a chromatic-aberration compensation element for compensating chromatic aberration caused by an objective lens for focusing beams on an information recording medium.~~

49. (Original) The optical head according to claim 48,
wherein the chromatic-aberration compensation element is formed on the objective lens.

50. (Original) The optical head according to claim 48,
wherein the chromatic-aberration compensation element and the objective lens are driven together by an actuator.

51. (Original) The optical head according to claim 48,
wherein the chromatic-aberration compensation element is a convex diffractive lens and forms converging light in cooperation with the objective lens.

52. (Newly Added) An optical head comprising:

at least one light source for emitting beams with a plurality of wavelengths;

a photodetector; and

at least one diffractive optical element provided in an optical path common to the

beams with different wavelengths,

wherein a first diffraction light and a second diffraction light are substantially different in diffraction order and are emitted from the at least one diffraction optical element with respect to the beams with a plurality of wavelengths.